

REMARKS

Claims 49-76 and 124-208 are pending in the above-captioned patent application after this amendment. Claims 49-76 and 124-208 have been rejected. Claims 70, 72, 186, 187, 203, and 204 have been objected to.

The Applicant respectfully disagrees with and respectfully traverses the rejection of claims 49-76 and 124-208.

Reconsideration of the pending application is respectfully requested in view of the arguments set forth below.

Rejection Under 35 U.S.C. § 112, Second Paragraph

Claims 70, 72, 186, 187, 203, and 204 have been rejected under 35 U.S.C. § 112, second paragraph. More particularly, the Examiner provides that "(c)laims 70 and 72 (Amended) recite the limitation 'whereas the magnitude of the beamlets that is directed toward the mask is compared with the magnitude of the signal measured by the detector assembly to inspect the mask'. It is unclear to one of ordinary skill in the art, how the first measurement (the magnitude of the beamlets that is directed toward the mask) is measured. Unlike the signal measured by the detector assembly (180 in Fig. 1A and 1B), this 'magnitude of the beamlets that is directed toward the mask' is not available to measurement, since any measurement will inevitably annihilate the signal to be detected by the detector assembly, unless the comparison is accomplished using a two-step measurement in sequence, i.e., the first one measuring the magnitude of the beamlets that is directed toward the mask 101, say I_0 , and the second one measuring the magnitude of the signal by the detector assembly 180 (Fig. 1B), the latter consisting of a signal transmitted through the mask measured by the first detector 182, I_T , another signal forwardly scattered by the mask measured by the second detector 184, I_S , and yet another signal reflected off by the mask measured by the third detector 106, I_R , the latter being explicitly recited in claim 71." The Examiner further provides that claims 186, 187, 203 and 204 recite similar limitations as that of claims 70 and 72, and are thus also rejected under 35 U.S.C. §112, second paragraph.

The Applicant respectfully asserts that the interpretation offered by the Examiner for

a two-step measurement in sequence is one way in which the magnitude of the beamlets that is **directed** toward the mask is measured and that one skilled in the art would readily recognize this method for measuring the magnitude of the beamlets that is **directed** toward the mask. Accordingly, the Applicant respectfully asserts that the rejection of claims 70, 72, 186, 187, 203 and 204 under 35 U.S.C. § 112, second paragraph, is incorrect and should be withdrawn.

Rejections Under 35 U.S.C. § 103(a)

Claims 49-51, 67, 68, 73-76, 124-126 and 140-143

Claims 49-51, 67, 68, 73-76, 124-126 and 140-143 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakasuji in view of Kobinata and Muraki et al., and further in view of Itoh et al. (USPAT 5,438,207), or Shimura et al. (USPAT 4,524,277), or Yasaka et al. (JP-405090140A). The Applicant respectfully traverses the rejection of claims 49-51, 67, 68, 73-76, 124-126 and 140-143 and respectfully submits that the rejection of claims 49-51, 67, 68, 73-76, 124-126 and 140-143 is improper.

The Examiner asserts that regarding claim 49, "Nakasuji describes a mask inspection system, comprising a source of electrons 1 shown in Fig. 1, as recited in Col.8/ll.19-22; a stage 79 supporting the mask 75 shown in Fig. 11, as recited in Col.21/ll.13-17; a beamlet shaping section 3 shown in Fig. 1, recited in Col.8/ll.24-34 or aperture 71/71a shown in Fig. 11, recited in Col.21/ll.3-11, disposed between the electron source 1 in Fig. 1 but not shown in Fig. 11 (upstream from electron beam EB) and the mask 75, as recited in Col.21/ll.13-17, the beamlet shaping section including a (first) multi-aperture array 71 having apertures 71a; a first electron lens group 2 directing electrons emitted from the source of electrons 1 into a collimated beam in an axial direction towards the (first) multi-aperture array 3, as shown in Fig. 1 and recited in Col.8/ll.22-34; a second electron lens group 72 & 73 shown in Fig. 11, as recited in Col.21/ll.12-13, or lens group 6 & 7 shown in Fig. 1, as recited in Col.8/ll.39-41, directing each beamlet in the array towards the center of a corresponding aperture in the second multiple array; an electron deflector 15 in Fig. 1 and 74 in Fig. 11, as recited in Col.21/ll.30-36; and a detector assembly 81 & 83 that measures electrons to inspect the mask 75, as recited in Col.21/ll.47-65.

"However, Nakasuji's device does not make use of a first and second multi-aperture arrays having apertures with a first and second shape, respectively. The use of (at least) two multi-aperture arrays is taught by Itoh et al. in numerals 112 and 116 shown in Fig. 1 and Fig. 2, as recited in Col.1/ll.56-68 and Col.5/ll.62, respectively. It is also taught by Shimura et al. in apertures 6 and 10 shown in Fig. 1, as recited in Col.2/ll.50-68 and Col.3/ll.1-6, and further by Yasaka et al. in apertures P1 and P2 shown in Fig. 1 & 3, as recited in the Constitution section, lines 3-7."

The Examiner provides that "(i)t would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Nakasuji's one aperture array with two multi-aperture arrays, in order to generate an electron beam of variable shapes determined by the intersection of the two apertures, as taught by Itoh et al., Shimura et al., or Yasaka et al."

The Examiner further states that "Nakasuji's device and method do not make use of a beamlet blanking section disposed between the beamlet shaping section and the mask. Kobinata discloses a mask inspecting device and method as shown in Fig. 2 and recited in the title and Abstract. As recited in Col.5/ll.18-32 and Col.6/ll.33-38, Kobinata's device and method make use of a blanking aperture 15 shown in Fig. 2 and Fig. 3, disposed between the mask M and the electron source 11, the latter being modified by Nakasuji's beamlet shaping section 71. In addition to Nakasuji's the step of measuring electrons by a detector assembly under a sequential superposition of electron beamlets forming a variable shaped exposure beam is taught by Kobinata in Col.7/ll.66-67 and Col.8/ll.1-4."

Additionally, with regard to claim 124, the Examiner asserts that "Nakasuji's beamlet shaping section comprises a multi-aperture array having M rows and N columns, as shown in Fig. 12 and recited in Col.21/ll.7-10."

The Applicant provides that Nakasuji is directed to an apparatus and methods for detecting defects in a pattern defined by a mask, reticle, wafer, or other "sample." The defect detecting inspection system includes an electron source that directs an electron beam EB toward an aperture plate 71 defining multiple apertures 71a to create multiple parallel electron beams EB_n . The electron beams EB_n then pass through a first condenser lens 72 and a second condenser lens 73 and a deflector 74 before encountering a sample 75 to be tested. The sample 75 comprises multiple subfields 78

each having one image that will be scanned by one of the electron beams EB_n .

As provided in Nakasuji, the dimension of each beam as focused on the sample is a $0.1\ \mu\text{m}$ by $0.1\ \mu\text{m}$ square at a pitch of $100\ \mu\text{m}$. The defect detecting inspection system is adapted to scannably irradiate the multiple charged particle beams EB_n simultaneously on respective measurement points ("loci") in an irradiation region on the surface of the sample 75. After each region is scanned, the sample 75 moves in either the x-direction or the y-direction and is scanned again in like manner. The inspection system further includes a detector assembly 81, 83, 84 that can be situated so as to detect charged particles passing through the irradiated region of the sample 75, or the detector assembly 81, 83, 84 can be situated so as to detect reflected electrons propagating from the loci in the irradiated region as a result of the electron beams EB_n impinging on the loci. (Nakasuji column 2, lines 1-24, column 10, lines 42-64, column 20, line 66 through column 22, line 7, and in Figures 1, 2(b) and 11).

However, Nakasuji provides no incentive for using different shapes for the spaced apart beamlets, or for giving the beamlets the same cross-sectional size or the same pattern as one of the desired areas. Nakasuji uses a simple shape, typically a $0.1\mu\text{m}$ by $0.1\mu\text{m}$ square, for the beamlets because each beamlet is designed to scan or trace the perimeter of one of the desired areas. Nakasuji is not designed to successively, stepwise, match adjacent desired areas arranged in a desired pattern. Therefore, the use of variable shaped beamlets that have the same cross-sectional shape or pattern of one of the desired areas will not make the inspection assembly of Nakasuji any more or less effective at tracing the perimeter of one of the desired areas. Accordingly, there is no basis in the art to combine the references as provided by the Examiner because variable shapes are not necessary or even relevant to a defect detecting inspection system that merely traces the outline of a given area.

Additionally, Nakasuji does not teach or suggest an inspection system that creates electron beams that have a cross-sectional shape of at least either a triangle or a rectangle. Further, Nakasuji does not teach or suggest a first multi-aperture array having a first shape, wherein a first portion of the first shape is substantially hexagon shaped. Yet further, Nakasuji does not teach or suggest an inspection system including at least one deflector to deflect the beamlets to fill in the spaces between adjacent

beamlets. Still further, Nakasuji does not teach or suggest an inspection system including a control system to control and adjust a first multi-aperture array and a second multi-aperture array so the shape of the electron beams can be easily changed between a first shape and a second shape that is different from the first shape.

Moreover, the Patent Office misconstrues the references that the Patent Office cites as using (at least) two multi-aperture arrays. Actually, Itoh et al. is directed to an electron beam direct writing system including an electron gun 11 for supplying an electron beam 13 that is shaped and focused on a surface of a semiconductor substrate 18 in relevant part by a first aperture member 12 having a single aperture and a second aperture member 16 having an evaluation aperture 15. (Itoh et al. column 1, line 56 through column 2, line 5, column 5, line 33 through column 6, line 4, and in Figures 1 and 2). Further, Shimura et al. is directed to an electron beam focusing system including an electron beam 2 produced by an electron gun 1 that is shaped and focused in relevant part by a first single aperture member 6 and a second single aperture member 10, wherein both aperture members 6, 10 are of a rectangular or square form. (Shimura et al. column 2, lines 45-67, and in Figure 1). Still further, Yasaka et al. is directed to an electron beam aligner including an electron beam from an electron gun 1 that is focused and shaped in relevant part by a first aperture mask P1 that has a single aperture and a second aperture mask P2. (Yasaka et al. Purpose, Constitution, and in Figure 1).

Accordingly, none of these references, Itoh et al., Shimura et al., or Yasaka et al., is directed to a system having two multi-aperture arrays to shape the electron beam passing through them. Additionally, Nakasuji does not provide incentive to modify its structure to include two multi-aperture arrays to shape the spaced apart beamlets because Nakasuji provides no incentive for using different shapes for the spaced apart beamlets. As discussed above, Nakasuji uses a simple shape, typically a $0.1\mu\text{m}$ by $0.1\mu\text{m}$ square, for the beamlets because each beamlet is designed to scan or trace the perimeter of one of the desired areas. Nakasuji is not designed to successively, stepwise, match adjacent desired areas arranged in a desired pattern as is the present invention. Therefore, the use of variable shaped beamlets will not make the inspection assembly of Nakasuji any more or less effective at tracing the perimeter of one of the desired areas.

Additionally, as provided by the Examiner, Kobinata is directed to a mask inspection apparatus 2 that includes in relevant part a blanking aperture 15 to help shape an electron beam from an electron gun 11. (Kobinata column 5, lines 15-31, and in Figures 2 and 3). Further, the Applicant provides that Muraki et al. is directed to an electron beam exposure apparatus and position detection apparatus including an electron gun 1 that generates electron beams that are shaped and focused in relevant part by a blanking aperture BA. (Muraki et al. column 6, line 59 through column 8, line 6, and in Figure 1).

However, neither Muraki et al. nor Kobinata is directed to the use of blanking apertures to create electron beams that have a cross-sectional shape of at least either a triangle or a rectangle. Further, the references do not provide any incentive to modify the structure of Nakasuji to include blanking apertures as taught by Muraki et al. or Kobinata to shape the spaced apart beamlets because Nakasuji provides no incentive for using different shapes for the spaced apart beamlets. Nakasuji uses a simple shape, typically a $0.1\mu\text{m}$ by $0.1\mu\text{m}$ square, for the beamlets because each beamlet is designed to scan or trace the perimeter of one of the desired areas. Nakasuji is not designed to successively, stepwise, match adjacent desired areas arranged in a desired pattern as is the present invention. Therefore, the use of variable shaped beamlets will not make the inspection assembly of Nakasuji any more or less effective at tracing the perimeter of one of the desired areas.

In contrast to the cited references, claim 49 of the present application recites "(a)n inspection system ... comprising: a source of electrons; a stage supporting the mask; a beamlet shaping section disposed between the source of electrons and the mask, the beamlet shaping section including a first multi-aperture array having apertures with a first shape and a second multi-aperture array having apertures with a second shape; a beamlet blanking section disposed between the beamlet shaping section and the mask; a first electron lens group directing electrons emitted from the source of electrons into a collimated beam in an axial direction towards the first multi-aperture array; a second electron lens group directing each beamlet in the array of electron beamlets formed by the first multi-aperture array towards the center of a corresponding aperture in the second multi-aperture array; an electron deflector disposed between the first multi-aperture array

and the second multi-aperture array; and a detector assembly that measures electrons to inspect the mask.”

These features are not taught or suggested by the cited combination of references. Accordingly, the rejection of claim 49 is unsupported by the art and should be withdrawn. Because claims 50, 51, 67, 68 and 73-76 depend either directly or indirectly from claim 49, the rejection of these claims is also not supported by the art.

Additionally, in contrast to the cited references, claim 124 of the present application recites “(a) method for inspecting a device with electrons ... comprising the steps of: generating electrons; directing the electrons in a collimated beam in an axial direction towards the device; directing the collimated beam of electrons through a beamlet shaping section comprising a first multi-aperture array having M rows and N columns of apertures having a first shape, a second multi-aperture array having M rows and N columns of apertures having a second shape; directing the electrons emerging from the beamlet shaping section through a beamlet blanking section; directing electron beamlets having the first shape formed by the first multi-aperture array towards the center of corresponding apertures in the second multi-aperture array; deflecting each of the electron beamlets formed by the first multi-aperture array away from the center of the corresponding aperture in the second multi-aperture array; and measuring electrons with a detector assembly to inspect the device.”

These features are not taught or suggested by the cited combination of references. Accordingly, the rejection of claim 124 is unsupported by the art and should be withdrawn. Because claims 125, 126 and 140-143 depend either directly or indirectly from claim 124, the rejection of these claims is also not supported by the art.

Claims 52-66 and 127-139

Claims 52-66 and 127-139 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakasuji in view of Kobinata and Muraki et al., and Itoh et al., or Shimura et al., or Yasaka et al., as previously applied to the respective parent claims 49, 51 and 126, and further in view of Sogard et al. (USPAT # 6,014,200).

As provided above, the rejection of claims 49 and 124 is unsupported by the art and should be withdrawn. Because claims 52-66 and 127-139 depend either directly or

indirectly upon independent claims 49 and 124 respectively, the rejection of these claims is also not supported by the art.

Claims 193 and 196-208

Claims 193 and 196-208 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakasuji in view of Kobinata and Muraki et al., and further in view of Itoh et al., or Shimura et al., or Yasaka et al., and Yamada et al. (USPAT # 6,137,111). The Applicant respectfully traverses the rejection of claims 193 and 196-208 and respectfully submits that the rejection of claims 193 and 196-208 is improper.

With regard to claim 193, the Examiner asserts that claim 193 recites the same limitations as previously rejected claim 124 plus some additional limitations as provided below. More specifically, the Examiner asserts that "Nakasuji's mask to be inspected (mask 75 in Fig. 11) has a plurality of desired transparent pattern 75b and a plurality of desired opaque areas 75a organized in a desired opaque pattern, the mask 75 including a plurality of actual transparent areas 75b and a plurality of actual opaque areas 75a, as shown in Fig. 11 and recited in Col.21/ll.17-23. As already applied to the rejection of claim 124 above, the use of (at least) two multi-aperture arrays is taught by Itoh et al. as well as by Shimura et al., and further, by Yasaka et al.

"The use of a control section that adjusts the positions of the first and second multi-aperture arrays so that the shape of the beamlets can be easily changed between a first shape and a second shape different than the first shape is conventional and well known in the art, for being the main and common purpose of using two (or more) multi-aperture arrays. This Official Notice is supported, e.g., by Itoh et al. as recited in Col.1/ll.51-52 in reference to using two multi-aperture arrays recited in Col.1/ll.58-68, by Yasaka et al., in reference to a general purpose shape in the Abstract 3-10, and further, by Shimura et al., as recited in Col.2/ll.62-67 and Col.3/ll.5-24."

The Examiner further provides that although "Itoh et al., Yasaka et al. and Shimura et al. use their inventions for photolithographic patterning of a wafer, it is generally known in the art that they are essentially no different than the general purpose electron beam exposure device & method. As such, they can be also used for mask inspections, as recited by Yamada et al. (USPAT # 6,137,111) in the Abstract/ll.1-7 (for

detecting mask deficiency or defect) and in Col.1/ll.11-17 (for forming a pattern on a wafer)."

As discussed above, Nakasuji provides no incentive for using different shapes for the spaced apart beamlets, or for giving the beamlets the same cross-sectional size or the same pattern as one of the desired areas. Nakasuji uses a simple shape, typically a 0.1 μ m by 0.1 μ m square, for the beamlets because each beamlet is designed to scan or trace the perimeter of one of the desired areas. Nakasuji is not designed to successively, stepwise, match adjacent desired areas arranged in a desired pattern as is the present invention. Therefore, to provide a control section to quickly change the shape of the beamlets will not make the inspection assembly of Nakasuji any more or less effective at tracing the perimeter of one of the desired areas. Accordingly, there is no basis in the art for modifying or combining the references as provided by the Examiner because variable shapes are not necessary or even relevant to a defect detecting inspection system that merely traces the outline of a given area.

In contrast to the cited combination of references, claim 193 of the present application recites "(a)n inspection system ... comprising: a beamlet supply assembly that directs a plurality of spaced apart beamlets toward the mask, the beamlet supply assembly including a first multi-aperture array and a second multi-aperture array; and a control section that adjusts the position of the first multi-aperture aperture array and the second multi-aperture array so that the shape of the beamlets can be easily changed between a first shape and a second shape that is different from the first shape."

These features are not taught or suggested by the cited combination of references. Accordingly, the rejection of claim 193 is unsupported by the art and should be withdrawn. Because claims 196-208 depend either directly or indirectly upon independent claim 193, the rejection of these claims is also not supported by the art.

Claims 144-192, 194 and 195

Claims 144-192, 194 and 195 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakasuji in view of Kobinata and Muraki et al., in view of Itoh et al., or Shimura et al., or Yasaka et al., and in further view of Yamada et al. and Sogard et al. (USPAT # 6,014,200). The Applicant respectfully traverses the rejection of claims

144-192, 194 and 195, and respectfully submits that the rejection of claims 144-192, 194 and 195 is improper.

More particularly, the Examiner asserts that "Nakasuji in view of Kobinata and Muraki et al in view of Itoh et al. or Shimura et al. or Yasaka et al., and further in view of Yamada et al. show all the limitations of claims 144-192 as previously applied to claims 196-208, except the recitations of a beamlet cross-section shaped as a triangle (claims 144-160) and a hexagon (claims 161-176), and further, a deflector to deflect the shaped beamlets to fill-in the spaces between adjacent shaped beamlets to substantially complete (one of) the desired patterns (claim 177-192).

"Regarding claim 144, the limitation of a beamlet cross-section shaped of at least a triangle is disclosed by Sogard et al. in Fig. 5C through Fig. 5F, and a rectangle in Fig. 5G to Fig. 5I, as recited in Col.9/II.31-67 & Col.10/II.1-5.

"Regarding claim 161, the limitation of a first multi-aperture array of a first shape having its first section substantially shaped as a hexagon, is disclosed by Sogard et al. in Fig. 5A, showing a section of the first shape 502 as being a hexagon, as recited in Col.9/II.31-36 and further emphasized in Col.9/II.43-45.

"Regarding claim 177, the limitation of a deflector to deflect the shaped beamlets to fill-in the spaces between adjacent shaped beamlets to substantially complete (one of) the desired patterns, is disclosed by Sogard et al. in Col.4/II.1-8 and Col.16/II.52-54."

The Examiner further states that "(i)t would have been obvious to one of ordinary skill in the art at the time the invention was made to adopt Sogard's lithographic patterning beamlet shapes (claims 144 & 161) and beamlets aerial occupation (claim 177) to modify the mask inspection apparatus and method of Nakasuji's previously modified by Kobinata, Muraki et al., Yamada et al. and Itoh et al. or Shimura et al. or Yasaka et al., since both lithographic patterning and mask inspection are based on electron beam exposure apparatus and method, as already suggested with regard to the rejection of claim 193 above."

As discussed above, Nakasuji provides no incentive for using different shapes for the spaced apart beamlets, or for giving the beamlets the same cross-sectional size or the same pattern as one of the desired areas. Nakasuji uses a simple shape, typically a 0.1 μ m by 0.1 μ m square, for the beamlets because each beamlet is designed to scan or

trace the perimeter of one of the desired areas. Nakasuji is not designed to successively, stepwise, match adjacent desired areas arranged in a desired pattern as is the present invention. Therefore, to shape the beamlets alternatively in a triangle and a rectangle shape, to use a first section of the apertures of the first multi-aperture array that is hexagon shaped, or to provide a deflector to fill in spaces between adjacent shaped beamlets will not make the inspection assembly of Nakasuji any more or less effective at tracing the perimeter of one of the desired areas. Accordingly, there is no basis in the art for modifying or combining the references as provided by the Examiner because variable shapes of the beamlets and matching desired areas are not necessary or even relevant to a defect detecting inspection system that merely traces the outline of a given area.

In contrast to the cited combination of references, claim 144 of the present application recites "(a)n inspection system ... comprising: a beamlet supply assembly that directs a shaped beamlet toward one of the actual areas of the mask, the shaped beamlet having a cross-sectional size and shape that corresponds to a cross-sectional size and shape of one of the desired areas, wherein the beamlet supply assembly selectively and alternatively adjusts the shaped beamlet to have a cross-sectional shape of at least a triangle and a rectangle."

These features are not taught or suggested by the cited combination of references. Accordingly, the rejection of claim 144 is unsupported by the art and should be withdrawn. Because claims 145-160 depend either directly or indirectly upon independent claim 144, the rejection of these claims is also not supported by the art.

Additionally, in contrast to the cited references, claim 161 of the present application recites "(a)n inspection system ... comprising: a beamlet supply assembly that directs a plurality of spaced apart beamlets toward the mask, the beamlet supply assembly including a first multi-aperture array having apertures with a first shape and a second multi-aperture array having apertures with a second shape that is different from the first shape, wherein a first section of the first shape is substantially hexagon shaped."

These features are not taught or suggested by the cited combination of references. Accordingly, the rejection of claim 161 is unsupported by the art and should be withdrawn. Because claims 162-176 depend either directly or indirectly upon independent claim 161,

the rejection of these claims is also not supported by the art.

Further, in contrast to the cited references, claim 177 of the present application recites "(a)n inspection system ... comprising: a beamlet supply assembly that directs a plurality of spaced apart, shaped beamlets toward the mask, wherein the plurality of spaced apart, shaped beamlets are organized in a pattern that is substantially similar to at least a portion of one of the desired patterns; and at least one deflector to deflect the shaped beamlets to fill in the spaces between adjacent shaped beamlets to substantially complete one of the desired patterns."

These features are not taught or suggested by the cited combination of references. Accordingly, the rejection of claim 177 is unsupported by the art and should be withdrawn. Because claims 178-192 depend either directly or indirectly upon independent claim 177, the rejection of these claims is also not supported by the art.

The Examiner further rejected claims 194 and 195 as containing similar limitations as contained in claim 144. Claims 194 and 195 depend either directly or indirectly from independent claim 193. As provided above, the rejection of claim 193 is not supported by the art. Accordingly, the rejection of claims 194 and 195 is also not supported by the art and should be withdrawn.

Remaining References

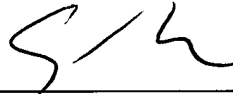
The references cited by the Examiner, but not relied on for the rejection of claims, have been noted. The remaining references are no more pertinent than the applied references, therefore, a detailed discussion of these remaining references is deemed unnecessary for a full and complete response to the Office Action.

CONCLUSION

In conclusion, the Applicant respectfully asserts that claims 49-76 and 124-208 are patentable for the reasons set forth above, and that the application is now in a condition for allowance. Accordingly, an early notice of allowance is respectfully requested. The Examiner is requested to call the undersigned at 858-456-1951 for any reason that would advance the instant application to issue.

Dated this the 8th day of January, 2004.

Respectfully submitted,



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